CLAIMS

1. An electrochemical pattern replication method for production of micro- or nano-structures of an electrically conductive material on a substrate (9), whereby an etching or plating pattern is replicated, defined by an electrically insulating patterned material, said method comprising

using an electrochemical process for transferring said pattern onto the substrate (9),

said electrochemical process comprising dissolving a material at an anodic surface and depositing the material at a cathodic surface, **characterized** by

placing a master electrode (8) in close contact with the substrate (9) so that the pattern is defined using the master electrode (8), and

said dissolving and depositing of material being performed in local etching or plating cells (12,14) being formed in closed or open cavities, delimited by an insulating pattern layer (3) of the master electrode (8), and the substrate (9),

the master electrode (8) being the anodic surface and the substrate being the cathodic surface and the material being dissolved being a predeposited material on the master electrode in the local plating cells (14), or

the substrate (9) being said anodic surface and the master electrode being said cathodic surface and said cavities being local etching cells (12).

2. The method according to claim 1, **characterized** by the steps of

charging the cavities on the master electrode (8) with an electrolyte solution (6);

compressing the substrate (9) and the master electrode (8) in close contact, thereby creating the local

etching cells (12) charged with the electrolyte solution (6); and

connecting an external voltage between the substrate (9), which is the anode, and the master electrode (8), which is the cathode.

3. The method according to claim 1, **characterized** by the steps of predepositing a plating material (15) in the cavities on the master electrode (8) and charging them with an electrolyte solution (6);

compressing the substrate (9) and the master electrode (8) in close contact, thereby creating the local plating cells (14) charged with the electrolyte solution (6); and

connecting an external voltage between the substrate (9), which is the cathode, and the master electrode (8), which is the anode.

4. The method according to any of claims 1 to 3, **characterized** by a distance between the master electrode (8) and the substrate (9) being determined by the thickness of the insulating pattern layer (3).

5. The method according to claim 2, **characterized** by a further step of cleaning of the master electrode (8), after a number of etching cycles.

6. The method according to claim 5, **characterized** by the cleaning step being an etching process, where deposit material (13) on the master electrode is etched away.

7. The method according to any of the preceding claims, **characterized** by using pulsed voltage applied between the master electrode (8) and the substrate (9).

8. The method according to claim 7, **characterized** in that the frequency is in the range of 2 to 20 kHz.

9. The method according to claim 7, **characterized** in that the frequency is 5 kHz.

10. The method according to any of claims 7 to 9, **characterized** in that the pulsed voltage is a periodic pulse reverse voltage.

11. The method according to any of claims 7 to 10, **characterized** in that the pulsed voltage has complex waveforms.

12. The method according to claim 2 or 3, **characterized** in that the electrolyte solution (6) has no or less supporting electrolyte and a high concentration of electro active species and/or no chemical oxidation agent.

13. The method according to claim 2 or 3, **characterized** in that counter ions in the electrolyte solution (6) is exchanged to ones which provide higher solubility.

14. The method according to claim 2 or 3, **characterized** in that a concentration of electro active ions of 10 to 1200 mM in the electrolyte solution (6) is used and/or that a sequestering agent is used.

15. The method according to claim 14, **characterized** in that sequestering agent is EDTA.

16. The method according to claim 2 or 3 , **characterized** in that an additive system is used in the

electrolyte solution (6), comprising wetting agents, accelerators, suppressors and/or levelers.

17. The method according to claim 2 or 3, **characterized** in that the electrolyte solution (6) comprises acid copper and the electrolyte (6) has a pH value between 2 and 5.

18. The method according to any of claims 12 to 17, **characterized** using said electrolyte solution (6) being an optimised electrolyte in the local etching cells (12) or the local plating cells (14).

19. An electrode suitable for an etching or plating process, **characterized** in that a counter electrode (1) and a pattern defining structure of an electro chemical etching or plating cell are integrated into a master electrode (8), wherein the counter electrode (1) is a conducting electrode layer (1') or a flexible conducting foil (1''), and the pattern defining structure is an insulating pattern layer (3) being applied on said counter electrode (1).

20. The electrode according to claim 19, **characterized** in that the counter electrode (1) is inert.

21. The electrode according to claim 19 or 20 **characterized** in that a flexible elastomer layer (20) is applied on the insulating pattern layer (3).

22. The electrode according to any of claims 19 to 21 **characterized** in that the counter electrode (1) is applied on a mechanical support layer (23).

23. The electrode according to claim 22 **characterized** in that a conductive elastomer layer (21) is applied between the counter electrode (1) and the mechanical support layer (23).

24. The electrode according to claim 21 or 22 **characterized** in that an intermediate metal layer (22) is applied between the insulating pattern layer (3) and the flexible elastomer layer (20).

25. The electrode according to any claim 19 **characterized** in that the flexible conducting foil (1'') is made of titanium.

26. The electrode according to claim 24 or 25 **characterized** in that the master electrode (8) comprises two counter electrodes (1) with a sacrificial photo-resist layer (17) applied in between and that contact parts of the master electrode, structures of the insulating pattern layer (3), are electrochemically anodised to form an isolating layer.

27. An apparatus for performing the method according to claim 1, **characterized** by comprising a master electrode (8) and means for creating conformable contact between the master electrode (8) and a substrate (9).

28. The apparatus according to claim 27, **characterized** in that said means are one or more elastomer layers in the master electrode construction.

29. The apparatus according to claims 27 or 28, **characterized** in that said means are combined with a conformable membrane.

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30. The apparatus according to claim 27, **characterized** in that there are conducting means for electrical connection to the master electrode (8) on an outer side (10) and electrical connection to the substrate (9) on a contact side (11).

31. The apparatus according to claim 27, **characterized** in that the master electrode (8) is fixed in the apparatus by an applied vacuum.

32. The apparatus according to claim 30, **characterized** in that said conducting means for electrical connections is a conducting piece (28) applied on the outer side (10) of the master electrode (8).

33. The apparatus according to any of claims 27 to 32, **characterized** in that the master electrode is fixed in the apparatus by a pressure against a conducting piece, said pressure exerted by the conformable membrane and/or a piston.

34. The apparatus according to claim 33, **characterized** in that said pressure when applied with the conformable membrane is combined with a reservoir containing gas or liquid.

35. The apparatus according to any of claims 27 to 34, **characterized** in that gas bubbles are eliminated from an electrolyte solution (6) and/or the reservoir by use of an externally applied vacuum, ultrasound or a combination of vacuum and ultrasound.

36. An electrochemical pattern replication method for production of micro- or nano-structures of an electrically conductive material on a substrate, whereby an etching or plating pattern is replicated, defined by an electrically insulating patterned material, said method comprising the steps of:

using an electrochemical process for transferring said pattern onto the substrate,

dissolving a material at an anodic surface and depositing the material at a cathodic surface, by

placing a master electrode in close contact with the substrate so that the pattern is defined using the master electrode, and

said dissolving and depositing of material being performed in local etching or plating cells being formed in closed or open cavities, delimited by an insulating pattern layer of the master electrode, and the substrate, wherein the master electrode is the anodic surface and the substrate is the cathodic surface and the material being dissolved is a predeposited material on the master electrode in the local plating cells.

37. The method according to claim 36, wherein the substrate is said anodic surface and the master electrode is said cathodic surface and said cavities are local etching cells.

38. The method according to claim 37, further comprising the steps of:

charging the cavities on the master electrode with an electrolyte solution;

compressing the substrate and the master electrode in close contact, thereby creating the local etching cells charged with the electrolyte solution; and

connecting an external voltage between the substrate, which is the anode, and the master electrode, which is the cathode.

39. The method according to claim 36, further comprising the steps of:

predepositing a plating material in the cavities on the master electrode and charging them with an electrolyte solution;

compressing the substrate and the master electrode in close contact, thereby creating the local plating cells charged with the electrolyte solution; and

connecting an external voltage between the substrate, which is the cathode, and the master electrode, which is the anode.

40. The method according to claim 36, wherein a distance between the master electrode and the substrate is determined by the thickness of the insulating pattern layer.

41. The method according to claim 38, further comprising the step of: cleaning of the master electrode after a number of etching cycles.

42. The method according to claim 41, wherein the cleaning step is an etching process, where deposit material on the master electrode is etched away.

43. The method according to claim 36, wherein a pulsed voltage is applied between the master electrode and the substrate.

44. The method according to claim 43, wherein the frequency is in the range of 2 to 20 kHz.

45. The method according to claim 43, wherein the frequency is 5 kHz.

46. The method according to claim 43, wherein the pulsed voltage is a periodic pulse reverse voltage.

47. The method according to claim 43, wherein the pulsed voltage has complex waveforms.

48. The method according to claim 38, wherein the electrolyte solution has no or less supporting electrolyte and a high concentration of electro active species and/or no chemical oxidation agent.

49. The method according to claim 38, wherein counter ions in the electrolyte solution are exchanged to ones which provide higher solubility.

50. The method according to claim 38, wherein a concentration of electro active ions of 10 to 1200 mM in the electrolyte solution is used and/or that a sequestering agent is used.

51. The method according to claim 50, wherein the sequestering agent is EDTA.

52. The method according to claim 38, wherein an additive system is used in the electrolyte solution, comprising wetting agents, accelerators, suppressors and/or levelers.

53. The method according to claim 38, wherein the electrolyte solution comprises acid copper and the electrolyte has a pH value between 2 and 5.

54. The method according to claim 38, wherein said electrolyte solution is an optimised electrolyte in the local etching cells or the local plating cells.

55. An electrode suitable for an etching or plating process, comprising a counter electrode and a pattern defining structure of an electro chemical etching or plating cell are integrated into a master electrode, wherein the counter electrode is a conducting electrode layer or a flexible conducting foil, and the pattern defining structure is an insulating pattern layer being applied on said counter electrode.

56. The electrode according to claim 55, wherein the counter electrode is inert.

57. The electrode according to claim 55, wherein a flexible elastomer layer is applied on the insulating pattern layer.

58. The electrode according to claim 55, wherein the counter electrode is applied on a mechanical support layer.

59. The electrode according to claim 58, wherein a conductive elastomer layer is applied between the counter electrode and the mechanical support layer.

60. The electrode according to claim 57, wherein an intermediate metal layer is applied between the insulating pattern layer and the flexible elastomer layer.

61. The electrode according to any claim 55, wherein the flexible conducting foil is made of titanium.

62. The electrode according to claim 61, wherein the master electrode comprises two counter electrodes with a sacrificial photo-resist layer applied in between and that contact parts of the master electrode, structures of the insulating pattern layer, are electrochemically anodised to form an isolating layer.

63. An apparatus for performing the method according to claim 36, comprising a master electrode and means for creating conformable contact between the master electrode and a substrate.

64. The apparatus according to claim 63, wherein said means are one or more elastomer layers in the master electrode construction.

65. The apparatus according to claims 63, wherein said means are combined with a conformable membrane.

66. The apparatus according to claim 63, wherein there are conducting means for electrical connection to the master electrode on an outer side and electrical connection to the substrate on a contact side.

67. The apparatus according to claim 63, wherein the master electrode is fixed in the apparatus by an applied vacuum.

68. The apparatus according to claim 66, wherein said conducting means for electrical connections is a conducting piece applied on the outer side of the master electrode.

69. The apparatus according to claim 63, wherein the master electrode is fixed in the apparatus by a pressure against a conducting piece, said pressure exerted by the conformable membrane and/or a piston.

70. The apparatus according to claim 69, wherein said pressure when applied with the conformable membrane is combined with a reservoir containing gas or liquid.

71. The apparatus according to claim 63, wherein gas bubbles are eliminated from an electrolyte solution and/or the reservoir by use of an externally applied vacuum, ultrasound or a combination of vacuum and ultrasound.